and apparatus are provided for simply and inexpensively enhancing an electronic audio signal in such a way that the quality of audible sound produced from the audio signal more closely approaches that of the original sound as if heard live in an acoustically designed environment. The present invention non-linearly distorts the audio signal by increasing the amplitude of [selective frequencies or harmonics in] the original audio signal at selective frequencies or harmonics such that an enhanced audio signal is produced which exhibits an improved harmonic quality compared to that of the original audio signal. In this way, the present invention can be seen as adding enhancing harmonics to the original audio signal. Sound produced from an audio signal enhanced in accordance with the present invention appears to resist becoming distorted at high volumes and tends to eliminate, or at least significantly reduce, the formation of sweet spots.

When an input audio signal having a band of frequencies ranging from a low end to a high end is transmitted through an apparatus according to the principles of the present invention, [the frequencies in] the input audio signal [are] is non-linearly distorted in amplitude. In particular, [frequencies in] the input audio signal at least increases in amplitude as per increasing frequencies from a desired reference frequency up to an amplitude peak at a high frequency. After this high frequency, it is desirable for the audio signal [frequencies] to decrease in amplitude as per increasing frequencies toward the high end. It is also desirable for the present apparatus to be further operatively adapted so that when the audio signal is transmitted therethrough, [other frequencies in] the input audio signal increases in amplitude as per decreasing frequencies from the reference frequency toward the low end

of the band and up to an amplitude peak at a low frequency. It is further desirable, after the low frequency, for the [other frequencies] input audio signal to decrease in amplitude as per decreasing frequencies toward the low end.

The previous amendment to page 20, line 23 of the DETAILED DESCRIPTION OF THE INVENTION section of the present specification (See the Amendment mailed April 21, 1997) is reproduced below in its entirety and additional amendments thereto are as indicated:

Each of the above described embodiments produce generally the same type of enhancement in an electronic audio signal. Broadly, an apparatus for enhancing the quality of an electronic audio signal, according to the principles of the present invention, comprises a circuit operatively adapted for distorting an input audio signal transmitted therethrough by non-linearly amplifying [enhancing harmonics or frequencies in] the input audio signal at enhancing harmonics or frequencies. By increasing the amplitude of the input audio signal [enhancing harmonics] in this manner, the resulting enhanced audio signal exhibits an improved harmonic quality compared to that of the input audio signal. Until the present invention, electronic audio signals were not enhanced in this manner. Accordingly, an apparatus for enhancing the quality of an electronic audio signal, according to the principles of the present invention, comprises any circuit operatively adapted for distorting an input audio signal transmitted therethrough into such an enhanced audio signal.

A typical electronic audio signal has a bandwidth of frequencies between a low end and a high end in the range of human hearing. The range of human hearing can vary, but

it typically ranges between about 20 Hz on the low end and about 20 KHz on the high end. One way of identifying a circuit according to the present invention is to transmit an electronic audio signal through the circuit, where the audio signal is in the form of a square wave having a band of frequencies ranging from a high end to a low end. When the square wave audio signal is so transmitted and viewed on an oscilloscope, the resulting frequency response curve of the output audio signal is non-linear and includes a portion having a positive slope that increases in amplitude from a desired reference point toward the high end of the signal and up to a high end amplitude peak. After the high end peak, this portion of the oscilloscope curve may then change to a negative slope that decreases in amplitude toward the high end. When the square wave audio signal is transmitted through some of the embodiments disclosed herein, the resulting frequency response curve of the output audio signal will also include another portion having a positive slope that increases in amplitude from the reference point toward the low end of the signal and up to a low end amplitude peak. After the low end peak, this other portion of the oscilloscope curve may then change to a negative slope that decreases in amplitude toward the low end.

It is desirable for the present circuit, such as some of the examples described above, to be designed such that the amplitude of the input audio signal at the reference frequency [in the audio signal] remains about the same when transmitted through the circuit. It is desirable for the input and output of a system according to the principles of the present invention, such as the above described exemplary circuits 10 and 100, to have volume levels that are perceptively about the same.

An enhanced audio signal, according to the present